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*Indian Standard*  
SPECIFICATION FOR  
WOVEN ASBESTOS TAPE FOR ELECTRICAL  
INSULATING PURPOSES

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INDIAN STANDARDS INSTITUTION  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
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# Indian Standard

## SPECIFICATION FOR WOVEN ASBESTOS TAPE FOR ELECTRICAL INSULATING PURPOSES

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\*Shri A. S. Lakshmanan was Chairman for the meeting at which this standard was finalized.

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# *Indian Standard*

## SPECIFICATION FOR WOVEN ASBESTOS TAPE FOR ELECTRICAL INSULATING PURPOSES

### 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 9 December 1970, after the draft finalized by the Insulating Materials Sectional Committee had been approved by the Electrotechnical Division Council.

**0.2** In the preparation of this standard, assistance has been derived from BS 1944 : 1953 'Specification for woven asbestos tape for electrical insulating purposes' issued by the British Standards Institution.

**0.3** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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### 1. SCOPE

**1.1** This standard covers plain, unimpregnated woven asbestos tape having selvages and furnished without sizing.

### 2. IDENTIFICATION

**2.1** Unless otherwise specified, the tape covered by this standard shall incorporate green warp threads woven into centre of the tape for identification purposes. By agreement between the purchaser and the manufacturer, the identification warp threads may be of other colours.

### 3. REQUIREMENTS

#### 3.0 General

**3.0.1 Yarn** — The yarn used in the manufacture of the tape shall be an asbestos yarn which shall be satisfactory in evenness, and reasonably free from defects, such as neps, slubs, knots and kinks. Very small quantity of

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**3.0.2 Tape** — The tape shall be woven firmly and uniformly and shall be calendered to obtain a smooth surface. The tape shall be free from loose, broken and uneven threads.

**3.1 Length** — Unless otherwise specified, the tape shall be supplied in rolls of 50 or 100 m length. Any other length may be agreed to between the purchaser and the manufacturer.

**3.1.1 Joints in Length** — The length in a roll shall be supplied without joints. Joints may, however, be permitted subject to agreement between the purchaser and the manufacturer for individual orders. In such cases, length of a short piece shall be not less than 20 m. The rolls containing a tape length up to and including 50 m shall not contain more than two short pieces. The number of short length pieces in rolls containing more than 50 m length of tape shall be agreed to between the purchaser and the manufacturer. The ends of the short length pieces shall be overlapped and stitched neatly across the whole width of the tape. Pins and other metal devices shall not be used for joining the ends.

**3.1.2 Measurement of Length** — In cases of disputes, the length of the roll shall be determined by the method prescribed in 5.1 of IS:1954-1969\*.

### 3.2 Width

**3.2.1** The nominal width of the tapes and tolerances shall be as given in Table 1.

**TABLE 1 NOMINAL WIDTH AND TOLERANCES**

NOMINAL WIDTH	TOLERANCE
mm	mm
10 } 15 }	± 1
20 } 25 } 30 } 35 } 50 }	± 1.5

**3.2.2 Measurement of Width** — The width of the tape shall be measured as prescribed in Appendix A.

### 3.3 Thickness

**3.3.1** The nominal thickness of the tapes and tolerances shall be as given in Table 2.

\*Methods for determination of length and width of fabrics (first revision).

TABLE 2 NOMINAL THICKNESS AND TOLERANCES

(Clause 3.3.1)

NOMINAL THICKNESS mm	TOLERANCE mm
0.20 } 0.25 }	$\pm 0.04$
0.30 } 0.40 }	$\pm 0.05$
0.50	$\pm 0.06$

**3.3.2 Measurement of Thickness** — The thickness of the tape shall be measured as prescribed in Appendix B.

**3.4 Number of Threads** — The number of warp and weft threads per 10 mm of the tape shall be not less than that given in Table 3.

TABLE 3 NUMBER OF THREADS

NOMINAL THICKNESS mm	WARP THREADS PER 10 mm	WEFT THREADS PER 10 mm
0.20	16.0	8.0
0.25	15.0	7.5
0.30	14.0	7.5
0.40	12.5	7.0
0.50	9.0	4.5

**3.4.1 Counting the Number of Threads** — The count on one specimen from each of the selected rolls shall be made in accordance with 5 of IS: 1963-1969\*.

NOTE — The coloured threads shall not be included in the count.

### 3.5 Breaking Strength

**3.5.1 Before Heating** — When determined in accordance with the method prescribed in Appendix C, the breaking load of the tape shall be not less than the value given in Table 4.

**3.5.2 After Heating** — When determined, after heating, and in accordance with the method prescribed in Appendix D, the breaking load of tape shall be not less than the value given in Table 4.

\*Methods for determination of threads per decimetre in woven fabrics (first revision).

**TABLE 4 BREAKING STRENGTH**

(Clauses 3.5.1 and 3.5.2)

NOMINAL THICKNESS mm	BREAKING LOAD	
	Before Heating kN per 10 mm Width	After Heating kN per 10 mm Width
0.20	0.030	0.018
0.25	0.035	0.021
0.30	0.040	0.024
0.40	0.060	0.036
0.50	0.095	0.057

**3.6 Asbestos Content** — When determined in accordance with the method prescribed in Appendix E, the asbestos content of the tape shall be not less than 78 percent.

**3.7 Conducting Inclusions** — When determined in accordance with the method prescribed in Appendix F, the number of conducting inclusions per 100 metre per 10 mm width of the tape, irrespective of thickness, shall not exceed 2.

**3.8 Insulation Resistance** — When determined in accordance with the method prescribed in Appendix G, the insulation resistance of the tape shall be as given in 3.8.1 and 3.8.2.

**3.8.1** After the tape specimen has been conditioned as specified in H-1, the insulation resistance per 10 mm width of the tape shall be not less than 10 M $\Omega$ .

NOTE — The insulation resistance is inversely proportional to the width of the tape.

**3.8.2** The specimen tested in accordance with 3.8.1 above shall then be dried as specified in H-2. The insulation resistance per 10 mm width of the tape shall then be not less than 200 M $\Omega$ .

**3.9 Electric Strength Along the Surface** — The tape shall withstand for one minute a voltage of 10 kV (rms) when tested as prescribed in Appendix J.

**3.10 pH of Water Extract** — The pH of the water extract shall be not less than 10 when determined in accordance with Appendix K.

#### 4. PACKING

**4.1** The tape shall be wound on a hard core of 10 mm internal diameter and of sufficient strength to withstand the pressure of the tape when

wound tightly on it. The core shall not loosen when the roll is dropped on the floor from a height of one metre.

## **5. MARKING**

**5.1** Each roll shall be legibly marked at both ends with the following information:

- a) A reference to this Indian Standard, 'Ref IS : 6230-1970';
- b) Manufacturer's name or trade-mark;
- c) Nominal width of the tape;
- d) Nominal thickness of the tape;
- e) Length of roll;
- f) Number and lengths of short length pieces, if any; and
- g) Month and year of manufacture.

**5.1.1** Each roll may also be marked with the ISI Certification Mark.

**NOTE** — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

## **6. SAMPLING**

**6.1** Unless otherwise agreed to between the buyer and the seller, the number of rolls to be selected at random from a lot and the criteria of conformity of the lot to the requirements of this standard shall be according to Appendix L.

# **A P P E N D I X   A**

*( Clause 3.2.2 )*

## **MEASUREMENT OF WIDTH**

### **A-1. MEASURING METHOD**

**A-1.1** The width of the tape shall be measured by means of a steel rule graduated to read in millimetres. The tape specimen from each roll used for length measurement shall be laid flat, without tension, on a hard smooth surface for the measurement. Two measurements of width shall be made on each of rolls selected.

## APPENDIX B

### ( Clause 3.3.2 )

#### MEASUREMENT OF THICKNESS

##### B-1. GENERAL

**B-1.1** The thickness of the tape shall be measured on a single layer for normal inspection purposes by means of either the ratchet micrometer or the dial micrometer method given in **B-2** and **B-3**. In cases of doubt or dispute, the dial micrometer method, as prescribed in **B-3**, shall be used.

**B-1.2** On each of the rolls selected, 20 measurements shall be made at random. Ten of these measurements shall be made on the selvages and 10 measurements between the selvages, where the width of the tape permits. Thus there will be 10 or 20 measurements on each roll as the case may be. The average thickness as calculated from the above measurements will be the thickness of the tape in the roll.

**B-1.2.1** For each roll, the number of measurements outside the tolerances specified in 3.3.2 shall not exceed 2 when 10 measurements are made and 3 when 20 measurements are carried out.

##### B-2. RATCHET MICROMETER METHOD

**B-2.1** The diameter of each anvil of the micrometer shall preferably be 10 mm and not more than 13 mm. In closing the micrometer, the ratchet shall be employed. The micrometer should be capable of reading correctly to 0.01 mm.

**B-2.2** Before the thickness of the tape is measured, the micrometer shall be closed on the tape at a point outside the area where thickness is to be measured. The micrometer shall then be opened not more than 0.15 mm and then moved into the area selected for measurement. The micrometer spindle shall be closed on the tape at a rate of about 0.05 mm/s. The closing motion shall be continued at the same rate until the ratchet has clicked three times, and then the reading of the micrometer shall be taken.

##### B-3. DIAL MICROMETER METHOD

###### B-3.1 Description of the Micrometer

**B-3.1.1** The micrometer shall consist of a dial type gauge mounted vertically on a frame which is provided with an anvil below the foot of the gauge. The micrometer shall also be provided with a table for supporting the tape during measurement of thickness. This shall consist of a smooth, plane, horizontal surface, surrounding the anvil and level with it, and of sufficient size to prevent any error in the measurement through bending of

the specimen. The table may conveniently constitute part of the base of the frame.

**B-3.1.2** In addition, the micrometer shall comply with the following requirements.

**B-3.1.2.1** The gauge shall comply with the requirements of Type 1, Grade B of IS : 2092-1962\* except that the main return spring and back lug shall be omitted. It shall be fitted with a revolution counter and rotatable bezel by means of which the micrometer may be adjusted to read zero.

**B-3.1.2.2** The gauge shall be provided with a foot having a hardened, polished, plane, circular face of  $10 \pm 0.02$  mm diameter, rigidly fixed to the plunger.

**B-3.1.2.3** The axial loading of the plunger shall be such that the calculated pressure exerted by the foot on the specimen is  $9.3 \times 10^4$  to  $10.3 \times 10^4$  N/m<sup>2</sup> when the dial reads zero. This may be attained by any acceptable means. One satisfactory method is the provision of a platform. The platform shall form part of the fixed dead-weight loading, shall be rigidly fixed at the top of the plunger, and shall be provided with means for supporting cylindrical weights which will increase to the desired value of the calculated pressure exerted by the foot. Such weights shall be supported with their cylindrical axis in line with the axis of the spindle.

**B-3.1.2.4** The spring, which is necessary to prevent backlash in the gauge, shall not produce a change of pressure greater than 500 N/m<sup>2</sup>.

**B-3.1.2.5** The gauge shall be fitted with a lever for raising and lowering the plunger so that contact with the specimen to be measured may be effected gently.

**B-3.1.2.6** The gauge shall be rigidly fixed to an arm which shall be integral with the base of the frame.

**B-3.1.2.7** The anvil shall be rigidly set in the frame and shall have a hardened, polished, plane, circular face of  $10 \pm 0.02$  mm diameter.

**B-3.1.2.8** The surfaces of the foot of the gauge and anvil shall be parallel to within 0.005 mm and shall be coaxial.

**B-3.1.2.9** The plunger shall move perpendicularly to the face of the anvil.

**B-3.1.2.10** The rigidity of the frame shall be such that a load of 4.9 N applied to the dial housing, out of contact with the plunger, does not produce a deflection greater than 0.002 mm as indicated on the micrometer dial.

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\*Specification for dial gauges.

### **B-3.2 Procedure**

**B-3.2.1** The micrometer shall be set on a firm base so that the anvil is horizontal.

**B-3.2.2** The micrometer shall be loaded so as to provide the prescribed pressure.

**B-3.2.3** The surfaces of the foot of the gauge and anvil shall be cleaned by placing a clean, smooth sheet of paper between them and withdrawing it, and the gauge shall then be made to read zero by the use of the adjustable bezel.

**B-3.2.4** The specimen of the tape shall be placed on the anvil in a single layer, flat and without tension. The foot of the gauge shall be lowered gently upon the tape at a rate of about 0.05 mm/s and the reading taken immediately after the easily visible movement of the pointer has ceased, unless otherwise agreed to between the purchaser and the manufacturer.

## **APPENDIX C**

*( Clauses 3.5.1 and D-1.2 )*

### **DETERMINATION OF BREAKING STRENGTH BEFORE HEATING**

#### **C-1. TEST PROCEDURE**

**C-1.1** The specimen shall first be conditioned in accordance with **H-1.1**. The unstretched length of the tape between the jaws of the testing machine shall be 150 mm. The tests shall be carried out at a temperature of  $27 \pm 2^\circ\text{C}$ . The straining jaw shall move at a constant speed of 5 mm/s until the specimen breaks. If, at a load less than the specified proof load, the specimen breaks in or at the jaw of the testing machine owing to incorrect clamping, the result of the test shall be discarded. Five tape specimens shall be tested from each of the rolls selected. For each roll, the average value of five test results shall satisfy the specified limit. If two or more of the test results within a roll do not satisfy the limit, then the roll shall be deemed not to comply with the standard even if the average for that roll satisfies the requirement.

Average of the total test results shall be taken as the average breaking strength of the tape.

**C-1.2** A tensile testing machine employing a constant rate of loading may be used as an alternative by agreement between the purchaser and the manufacturer.

## APPENDIX D

( Clause 3.5.2 )

### DETERMINATION OF BREAKING STRENGTH AFTER HEATING

#### D-1. TEST PROCEDURE

**D-1.1** Five specimens shall be cut from each of the rolls used for the breaking strength test without heating.

**D-1.2** The specimens shall be exposed for 1 hour to a temperature of  $200 \pm 5^{\circ}\text{C}$ . At the end of this treatment the specimen should be brought to  $27 \pm 2^{\circ}\text{C}$  in a desiccator and then the breaking strength of the specimens shall be determined as prescribed in Appendix C.

## APPENDIX E

( Clause 3.6 )

### DETERMINATION OF ASBESTOS CONTENT

#### E-1. TEST PROCEDURE

**E-1.1** From each selected roll, one test piece, each not less than 5 g, and representative of the material, shall be weighed separately. They shall be placed in crucibles which have been previously heated to  $875 \pm 25^{\circ}\text{C}$ , maintained at this temperature for one hour, cooled in a desiccator and weighed to the nearest 0.001 g. They shall then be dried to constant weight at  $105$  to  $110^{\circ}\text{C}$  and the weight recorded to the nearest 0.001 g.

Note — By constant weight is meant the weight which does not differ by more than 0.1 percent from the preceding value.

**E-1.2** The weight of the crucible shall be subtracted in order to obtain the oven-dry weight of the test piece. The interval between two consecutive weighings during the process of drying should be one hour.

**E-1.3** The crucibles containing the specimens shall be placed in an oven and heated for not less than one hour at  $875 \pm 25^{\circ}\text{C}$ . They shall then be removed from the oven, and cooled in a desiccator to room temperature and weighed. The weight of the crucible shall be subtracted in order to obtain the weight of the ignited asbestos.

#### E-2. CALCULATION

**E-2.1** The asbestos content shall be calculated as follows:

$$\text{Asbestos, percent} = \frac{A \times 100}{B \times K}$$

where

$A$  = weight of the test piece in grams after ignition;

$B$  = dry weight of test piece in grams; and

$K$  = 0.86, water of crystallization factor.

**E-2.1.1** The asbestos content is the arithmetic mean of the two (or more) results.

## APPENDIX F

( Clause 3.7 )

### DETERMINATION OF NUMBER OF CONDUCTING INCLUSIONS

#### F-1. TEST PROCEDURE

**F-1.1** The tape from each selected roll shall be drawn at a rate of 90 mm/s between brass rollers, which shall be smoothly finished, of 40 mm diameter, and of width exceeding that of the tape to be tested. The weight of the uppermost roller shall be so adjusted that it develops a load of approximately 5N on the tape.

**F-1.2** An alternating voltage of a value given below shall be applied between the rollers:

<i>Nominal Thickness of Tape</i>		<i>Voltage</i>
Over	Up to and Including	
mm	mm	V( rms )
—	0.3	300
0.3	0.5	450

**F-1.3** The test voltage shall be of any convenient frequency between 25 and 100 Hz. It shall be of approximately sine-wave form and the ratio of the peak value to the rms value shall be within the limits of  $\sqrt{2} \pm 5$  percent ( 1.34 to 1.48 ).

**F-1.4** The test voltage shall be measured by means of an rms voltmeter connected across the output winding of a transformer.

**F-1.5** Means ( for example, a relay and counter in series with the rollers ) shall be provided for indicating and counting the occurrence of a conducting inclusion.

**F-1.6** The sensitivity of the relay and counter shall be such that it will operate when the tape transverse resistance falls to 10 000  $\Omega$  for 3 milli-seconds, it shall also operate at any lower resistance.

## **APPENDIX G**

*( Clauses 3.8 and J-1.1 )*

### **DETERMINATION OF INSULATION RESISTANCE**

#### **G-1. GENERAL**

**G-1.1** Measurement of insulation resistance shall be carried out on specimens conditioned or dried in the appropriate controlled atmosphere specified in **H-1** and **H-2** as required in **3.8.1** and **3.8.2**.

#### **G-2. TEST PROCEDURE**

**G-2.1** One specimen from each of the rolls selected for the test shall be cut to a length of approximately 75 mm.

**G-2.2** The resistance of the specimen shall be determined on a clear length of 50 mm; the ends of the specimen shall be clamped tightly between the jaws of metal clamps ( spaced 50 mm apart ) and these shall make good contact with the full width of the tape. The edges of the clamps shall be at right angles to the selvages of the tape. One clamp shall be suspended from a suitable fixture, and the specimen, together with the other clamp, shall be allowed to hang vertically. The weight of the lower clamp, together with an additional weight, if necessary, shall be equivalent to 490 N per metre width of the tape. Precautions shall be taken to ensure that the leads connected to the clamps do not touch material which is in parallel with the test specimen. The test voltage in all cases shall be 500 V dc and a direct deflection method is usually found to be the most convenient. In making observations, the current shall be determined 15 seconds after the initial application of the voltage. Observation shall be made with the current flowing in alternate directions, each reading in the reverse direction being separated from the reading taken in the forward direction by an interval of 1 minute. The mean of the two readings shall be used to compute the resistance of the specimen in this case. If the current is found to vary with time, a number of readings shall be taken as above, but in one direction only, and a curve plotted showing the relationship between the resistance and the duration of application of the voltage. The 1 minute value obtained from the curve shall then be deemed to be the insulation resistance of the tape.

**G-2.3** During the period from the end of the conditioning to the end of the resistance test, the specimen shall only be exposed to an atmosphere of

the same relative humidity as that to which it was exposed during the conditioning period, and shall not be touched with the naked hand, the use of rubber gloves or of forceps being recommended.

## APPENDIX H

( *Clauses 3.8.1, 3.8.2, C-1.1, G-1.1 and J-1.1* )

### CONDITIONING

#### H-1. STANDARD CONDITIONING PROCEDURE

**H-1.1** The specimens shall be subjected, in a loose unrolled state, to a controlled atmosphere at a temperature of  $27 \pm 2^{\circ}\text{C}$  and relative humidity of  $65 \pm 2$  percent for not less than 24 hours.

**H-1.1.1** For tests in which conditioning is required, whenever possible, the specimen shall be tested without removal from the conditioning atmosphere. If this is impracticable, the test may be carried out in an atmosphere of relative humidity of  $65 \pm 5$  percent within 3 minutes after removal of the specimen from the controlled atmosphere.

**H-1.2** A convenient way of obtaining the standard conditioning atmosphere within a small enclosed space or conditioning cabinet, is to use a saturated solution of a mixture of sodium chloride and sodium nitrate. The saturated solution is prepared by boiling in water a mixture of 1 part sodium chloride and  $2\frac{1}{2}$  parts sodium nitrate and subsequent cooling, then adding an excess of the solid mixture over the amount required for complete solution. The solution is thus maintained at saturation by the presence of the undissolved solute. Precautions shall be taken to prevent contamination by the humidifying salts of the specimens being conditioned. The floor of the cabinet shall be nearly covered by the largest possible shallow dish containing the solution and the undissolved solute. The temperature of the enclosed air shall be maintained at  $27 \pm 2^{\circ}\text{C}$  and it is desirable, for the rapid establishment of uniform equilibrium conditions, that forced circulation of the air should be provided by a small fan.

**H-1.3** The specimens to be conditioned shall be separately suspended in a loose unrolled state or otherwise disposed within the cabinet so as to allow free circulation of the air between and about them.

#### H-2. STANDARD DRYING PROCEDURE

**H-2.1** The specimens in a loose unrolled state, shall be dried for 1 hour in a controlled atmosphere in an oven operating at a temperature of  $110^{\circ}\text{C}$ .

**H-2.1.1** For tests in which drying is necessary, whenever possible, the tests on the specimens shall be carried out without their removal from the oven in dry atmosphere, the temperature of the oven being maintained at  $27 \pm 2^{\circ}\text{C}$ .

## **APPENDIX J**

*( Clause 3.9 )*

### **DETERMINATION OF ELECTRIC STRENGTH ALONG THE SURFACE**

#### **J-1. TEST PROCEDURE**

**J-1.1** From each selected roll, one tape specimen shall be conditioned as specified in **H-1**. The test specimen shall be approximately 50 mm long and shall be held between metal clamps as described in Appendix G except that the length between the jaws of the clamps shall be 25 mm. The test voltage shall be provided by a transformer and shall be alternating of any convenient frequency between 25 and 100 Hz. It shall be of approximately sine-wave form and the peak factor shall be within the limits of  $\sqrt{2} \pm 5$  percent ( 1.34 to 1.48 ). The peak value of the test voltage may be measured by a peak voltmeter in which case the rms value for the purpose of this test shall be considered as the peak value so determined divided by  $\sqrt{2}$ . Alternatively, the test voltage may be determined by a voltmeter suitably connected to the input or output side of the testing transformer and calibrated against a sphere gap.

**J-1.2** When measuring the test voltage by means of a voltmeter connected across the input windings of a transformer, care shall be taken that the leakage current with a poor specimen does not reduce the output voltage to a degree causing serious errors.

**J-1.3** The test shall be commenced by applying one-third of the specified proof voltage between the clamps. This voltage shall be increased at the rate of approximately 1 kV/s to the proof voltage of 10 kV (rms) which shall then be maintained for 1 minute.

## **APPENDIX K**

*( Clause 3.10 )*

### **DETERMINATION OF pH OF WATER EXTRACT**

#### **K-1. EXTRACTION**

**K-1.1** A water extract of the tape shall be prepared as follows.

**K-1.1.1** From each selected rolls, one specimen of the tape shall be cut into strips about  $20 \times 3$  mm. A weight of tape in the ratio of 1 g of the

strips to 100 ml of distilled water having a  $pH$  not less than 6.6 and a conductivity not greater than 2 microsiemens/cm shall be put into a 250-ml round-bottomed borosilicate glass (high grade resistance glass) or quartz flask, fitted with a reflux condenser of either the same quality glass or quartz. The apparatus shall have interchangeable conical ground-glass joints. The water shall be boiled for 10 minutes, care being taken not to char the tape. It shall then be cooled as rapidly as possible, using a carbon-dioxide trap fitted to the condenser.

## **K-2. $pH$ DETERMINATION**

**K-2.1 General**—The  $pH$  of the extract shall be determined by an electrometric method as soon as possible after the preparation of the extract.

**K-2.2 Outline of the Method**—Electrometric  $pH$  measurements are made with a suitable electrode system which develops a potential (emf) proportional to the  $pH$  of the solution.

### **K-2.3 Apparatus**

**K-2.3.1  $pH$  Meter**—The  $pH$  meter shall be of direct reading type conforming to IS : 2711-1966\*.

**K-2.3.2 Calomel and Glass Electrodes**—Saturated calomel electrode shall be used in  $pH$  meter assembly. A few crystals of solid potassium chloride shall be present within the chamber surrounding the calomel, at each temperature. The design of the electrode shall be such as to allow a fresh liquid junction between the solution of potassium chloride and the buffer solution or the extract.

The glass electrode shall be calibrated as prescribed in **K-2.4.1**. If the electrodes are used outside the electrode compartment of the assembly, the leads shall be protected from the effects of body capacitance.

To attain equilibrium as quickly as possible when using a glass electrode, the electrode shall be kept under water when not in use so that it does not become dry externally.

### **K-2.4 Procedure**

**K-2.4.1 Standardization**—The assembly shall be put on, allowed to warm up thoroughly and brought to electrical balance in accordance with manufacturer's instructions. The glass and calomel electrodes and the sample cup shall be thoroughly washed with distilled water twice and wiped dry with a clean absorbent paper. The temperature of the extract shall be noted and the temperature dial of the meter adjusted to proper setting. Two standard solutions shall be selected from Table 5 so as to bracket the anticipated  $pH$  of the extract and the standard solutions shall be brought to the temperature of the test solution within 2°C. The sample cup shall be filled with the first standard solution and the electrodes immersed. The

\*Specification for direct reading  $pH$  meters (revised).

dial of the meter shall be set to the known  $pH$  or potential corresponding to the known  $pH$  of the standard solution at appropriate temperature. The meter shall be brought to balance by engaging button and rotating asymmetry potential knob. The sample cup shall be repeatedly filled with additional portions of standard solution until the meter remains in balance within  $\pm 0.02$   $pH$  unit for two successive portions without a change in the position of the asymmetry knob. To eliminate the effect of thermal and electrical hysteresis, the temperature of electrodes, standard solutions and wash water shall be kept very close to that of the extract.

The electrodes and sample cup shall be thoroughly washed with water and a fresh liquid junction formed. The second standard solution shall be placed in the cup and the meter adjusted to new balance point and the  $pH$  read. The setting on the asymmetry potential knob shall not be changed. Additional portions of second standard solution shall be used until successive readings of  $pH$  agree within 0.05 unit. The meter is deemed to work satisfactorily if the reading obtained for the second standard solution is within the permissible limits of error.

If the anticipated  $pH$  of the solution is greater than 10, disodium tetraborate and saturated calcium hydroxide solutions (see Table 5) shall be used for standardization. The meter, in this case, is considered to be working satisfactorily if the reading obtained for the second standard solution agrees with the assigned  $pH$  within 0.1 unit.

If the  $pH$  determinations are made only occasionally, the meter shall be standardized each time.

TABLE 5 STANDARD SOLUTIONS

( Clause K-2.4.1 )

SL No.	TEMPERATURE °C	pH OF SOLUTION				
		0.05 M Potassium Tetroxalate	0.05 M Potassium Hydrogen Phthalate	0.025 M Potassium Dihydrogen Phosphate + 0.025 M Disodium Hydrogen Phosphate	0.01 M Disodium Tetraborate	Saturated Calcium Hydroxide
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	0	1.67	4.01	6.98	9.46	13.43
ii)	10	1.67	4.00	6.92	9.33	13.00
iii)	20	1.68	4.00	6.88	9.22	12.63
iv)	25	1.68	4.01	6.86	9.18	12.45
v)	30	1.69	4.01	6.85	9.14	12.30
vi)	35	1.69	4.02	6.84	9.10	12.14
vii)	40	1.70	4.03	6.84	9.07	11.99
viii)	50	1.71	4.06	6.83	9.01	11.58
ix)	60	1.73	4.10	6.84	8.96	11.45

**K-2.4.2 pH of the Water Extract** — The electrodes and sample cup shall be washed and wiped dry with a clean absorbent paper. The cup shall be filled with a portion of the extract and a fresh liquid junction formed. The meter is operated and pH directly read. In case of well buffered extract, one to three portions will usually be sufficient to yield pH values reducible to  $\pm 0.05$  unit. In case of slightly buffered solutions or distilled water six or more portions may be necessary.

**K-2.4.3 Results** — Report the pH obtained to the nearest 0.1 unit.

## APPENDIX L

( Clause 6.1 )

### SAMPLING OF WOVEN ASBESTOS TAPE

#### L-1. LOT

**L-1.1** All the rolls of woven asbestos tape of the same type, nominal width and nominal thickness manufactured from the same material under essentially similar conditions shall constitute a lot.

#### L-2. SCALE OF SAMPLING

**L-2.1** The number of rolls ( sample size ) to be selected at random from a lot depends on the size of the lot and shall be according to Table 6 for the characteristics listed therein.

**L-2.1.1** For random selection procedures, reference may be made to IS : 4905-1968\*.

**L-2.2** For other characteristics, the sample size shall be as given below.

**L-2.2.1** For asbestos content and pH, the composite sample shall be two or more rolls.

**L-2.2.2** For insulation resistance and electric strength along the surface, the composite sample shall be 2 percent of the number of rolls in the lot, subject to minimum 5 and maximum 25.

#### L-3. CRITERIA FOR CONFORMITY

**L-3.0** Each lot shall be tested separately for ascertaining the conformity of the tape to the requirements of this standard.

**L-3.1** The lot shall be declared conforming to the requirements of this standard, if the number of defective rolls in respect of each of the

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\*Methods for random sampling.

**TABLE 6 SCALE OF SAMPLING AND CRITERIA FOR CONFORMITY***(Clauses L-2.1, L-3.1 and L-3.2)*

NUMBER OF ROLLS IN THE LOT	LENGTH (INCLUDING SHORT LENGTH PIECE) AND NOMINAL WIDTH		NOMINAL THICKNESS, BREAKING STRENGTH AND CONDUCTING INCLUSIONS		NUMBER OF THREADS
	Sample Size	Permissible Number of Defective Rolls	Sample Size	Permissible Number of Defective Rolls	
(1)	(2)	(3)	(4)	(5)	(6)
Up to 100	5	0	5	0	3
101 „ 300	8	1	5	0	4
301 „ 500	13	1	8	0	5
501 „ 1 000	20	2	8	0	6
1 001 and above	32	3	13	1	7

characteristics, length (3.1) and nominal width (3.2) does not exceed the permissible number of defectives given in col 3 of Table 6.

**L-3.2** The lot shall be declared conforming to the requirements of this standard, if the number of defective rolls in respect of each of the three tests, nominal thickness (3.3), breaking strength (before and after heating) (3.5), and conducting inclusions (3.7) does not exceed the permissible number of defectives given in col 5 of Table 6.

**L-3.3** For number of threads (3.4), asbestos content (3.6), insulation resistance (3.8), electric strength along the surface (3.9), and pH (3.10), the lot shall be declared conforming to the requirements of this standard, if no failure occurs in any of the selected rolls for each of these characteristics.

# INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

## Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

## Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

## Derived Units

Quantity	Unit	Symbol	Conversion
Force	newton	N	1 N = 1 kg.1 m/s <sup>2</sup>
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m <sup>2</sup>
Frequency	hertz	Hz	1 Hz = 1 c/s (s <sup>-1</sup> )
Electric conductance	siemens	S	1 S = 1 A/V
Pressure, stress	pascal	Pa	1 Pa = 1 N/m <sup>2</sup>

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